NOTE

Phytic Acid, Saponins, and Polyphenols in Weaning Foods Prepared from Oven-Heated Green Gram and Cereals

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Protein-energy malnutrition is a syndrome that often occurs during the crucial weaning phase of a child's life. Weaning foods manufactured commercially by employing roller drying or extrusion cooking are prohibitively expensive for many people, especially in rural areas (Malleshi and Desikachar 1982). Although cereals and pulses constitute an important source of dietary calories and protein for much of the world's population, especially in developing countries, their utilization for human nutrition is limited because they contain inherent antinutritional factors (Salunkhe 1982). Domestic processing, such as roasting and malting, has been shown to reduce the levels of phytic acid (Khokhar and Chauhan 1986, Kataria et al 1988), polyphenols (Jood et al 1987), and saponins (Jood et al 1986) in legumes. In this study, three weaning foods composed of green gram (*Vigna radiata*) blended with rice (*Oryza sativa*), *kangini* (*Setaria italica*), or *sanwak* (*Echinochloa frumentacea*) were developed. Oven heating was the domestic processing employed in preparing the cereal-legume weaning foods. Foods were analyzed for their proximate composition and caloric content, and the effects of heating on phytic acid, saponins, and polyphenols were determined.

All seeds were procured from the local market in a single lot. The seeds were freed manually from dust, broken seeds, and other foreign material. Rice, *kangini, sanwak*, and green gram were heated separately in an oven at 70°C for 2 hr, then ground in a cyclone mill (mesh size 0.5 mm). Three blends of cereal, legume, and jaggery (cane sugar concentrate) (in the ratio 56:24:20) were prepared. Blend I contained rice and green gram; blend II had *kangini* and green gram; and blend III contained *sanwak* and green gram.

The weaning foods were analyzed for moisture (vacuum oven method), total nitrogen (micro-Kjeldahl method), ash, crude fat, crude fiber, and calories (using a bomb calorimeter), employing AOAC (1980) methods. A factor of 6.25 was used to convert N to crude protein. Iron was determined using spectrophotometry according to the method of Lindsey and Norwell (1969). Phytic acid was extracted in 0.5*M* nitric acid and estimated by the method of Davies and Reid (1979). Saponin was extracted and determined by the method of Gestetner et al (1966). Total polyphenols were extracted by the method of Singh and Jambunathan (1987) and estimated as tannic acid equivalent according to the procedure of Swain and Hills (1959). All the mixtures were analyzed in triplicate for the above-mentioned parameters. Data thus obtained were subjected to analysis of variance according to the standard methods of statistical analysis (Snedecor and Cochran 1967).

The moisture, protein, ash, fat, iron, crude fiber, and calorie content of the weaning foods are presented in Table I. In spite of variations, all the values in these weaning foods were within the ranges prescribed by the Indian Standards Institute (ISI 1969) for processed weaning foods. The phytic acid, saponin, and polyphenol contents of the weaning foods are presented in Table II. A marked decrease of about 33–39% in phytic acid content was observed in the processed weaning foods and could be attributed to the heating of the cereals and pulse. Oven heating has reportedly destroyed phytic acid in Bengal gram (*Cicer arietinum*) (Khan et al 1988). However, some of the decrease in phytic acid in the heated samples might have resulted from the formation of complexes of phytic acid with protein and minerals that were not extractable in dilute HNO_3 and therefore not measurable by the method used.

The saponin content of the weaning foods ranged from 1,166 to 1,264 mg/100 g and decreased 46–53% in the weaning foods prepared from oven-heated seeds. Roasting has been reported to reduce the saponin content of the moth bean (*Vigna aconitifolia*) (Khokhar and Chauhan 1986), chickpea (*Cicer arietinum*), and black gram (*Vigna mungo*) (Jood et al 1986, Kataria et al 1988).

The polyphenol content of the weaning foods ranged from 344.3 to 407.6 mg/100 g. Heating the seeds resulted in significant decreases (45–51%) in the measurable polyphenol content of the weaning foods. Cooking also reportedly decreased the polyphenol content of mung bean (*Vigna radiata*) (Barroga et al 1985), pigeon pea (*Cajanus cajan*), and cow pea (*Vigna unguiculata*) (Ekpenyong 1985). However, phenols react with proteins, forming poorly extractable protein-phenol complexes, which could result in low analytical results.

Blends of oven-heated pulse and cereals could meet the nutritional needs of infants by providing 357–374 Kcal, 10.28–13.71 g of protein, and 14.42–15.53 mg of iron per 100 g of product. Oven heating, a simple, commonly used household processing

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TABLE I
Chemical Composition (db) of Weaning Food Blends[a]

Weaning Food Blend[b]	Moisture (%)	Protein (%)	Ash (%)	Fat (%)	Iron (mg/100 g)	Crude Fiber (%)	Calories (Kcal/100 g)
I	5.7 ± 0.1	10.3 ± 0.3	2.9 ± 0.1	0.8 ± 0.1	15.0 ± 0.8	1.1 ± 0.1	374.0 ± 3.0
II	5.1 ± 0.1	13.7 ± 0.03	3.8 ± 0.1	1.9 ± 0.1	15.5 ± 1.4	1.3 ± 0.1	357.0 ± 4.0
III	5.2 ± 0.1	10.5 ± 0.3	3.1 ± 0.1	1.6 ± 0.1	14.4 ± 0.8	1.0 ± 0.9	359.5 ± 3.5
SEM[c]	0.0006	0.15	0.06	0.03	1.37	0.05	2.47
LSD ($P < 0.05$)	0.002	0.44	0.18	0.10	4.04	0.15	7.51

[a] Values are means ± SD of six independent determinations.
[b] Blends contained 56% cereal flour, 24% green gram flour, and 20% jaggery. The cereal flours in blends I, II, and III were rice, *kangini*, and *sanwak*, respectively.
[c] Standard error of the mean.

TABLE II
Phytic Acid, Saponins, and Polyphenols (mg/100 g, db) in Weaning Food Blends[a]

Weaning Food Blend[b]	Phytic Acid		Saponins		Polyphenols	
	Amount	Percent Decrease[c]	Amount	Percent Decrease[c]	Amount	Percent Decrease[c]
I						
Unprocessed (raw)	686.7 ± 3.4	...	2,176.0 ± 26.6	...	698.5 ± 16.5	...
Oven-heated	414.4 ± 3.1	39	1,166.0 ± 31.3	46	344.3 ± 18.3	51
II						
Unprocessed (raw)	728.3 ± 2.5	...	2,308.0 ± 23.7	....	726.0 ± 17.2	...
Oven-heated	445.9 ± 3.1	39	1,228.0 ± 23.7	47	382.1 ± 14.9	47
III						
Unprocessed (raw)	714.6 ± 3.6	...	2,714.0 ± 25.7	...	741.6 ± 8.65	...
Oven-heated	479.6 ± 2.66	33	1,264.0 ± 32.9	53	407.6 ± 16.6	45
SEM[d]	1.59		17.04		6.73	
LSD ($P < 0.05$)	4.59		49.16		19.43	

[a] Values are means ± SD of three independent determinations.
[b] Blends contained 56% cereal flour, 24% green gram flour, and 20% jaggery. The cereal flours in blends I, II, and III were rice, *kangini*, and *sanwak*, respectively.
[c] Due to processing.
[d] Standard error of the mean.

method, apparently resulted in significant reduction in phytic acid, saponins, and polyphenols of cereal-pulse mixtures. Thus, weaning foods prepared from locally available food ingredients could be used as supplements for meeting the nutritional requirements of infants.

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